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Clinical Evaluation and Early Finishing of Glass Ionomer Restorative Materials

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Clinical Evaluation and Early Finishing of Glass Ionomer Restorative Materials

BRUCE A MATIS • MICHAEL COCHRAN
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Summary

A new generation of glass-ionomer cements has been introduced with the claim that finishing can be accomplished 15 minutes after placement. Thirty patients with at least four cervical erosion/abrasion lesions participated. Of the four lesions, one was restored with Chelon, one with Cervident, one with Ketac-Fil finished in 15 minutes, and one with Ketac-Fil finished in 24 hours after placement. Six criteria—retention, anatomical

form, staining, marginal discoloration, marginal adaptation, and surface roughness—were evaluated after six months, one year, two years, and three years. No significant differences were found between any of the criteria in the Ketac-Fil restorations after three years. Glass ionomers exhibited 90% Alpha ratings and Cervident presented 50% Alpha ratings in retention at the final examination.

INTRODUCTION

A dental restorative material capable of forming an adhesive bond with dentin would have many practical applications in clinical dentistry. Such a system would improve the treatment of cervical erosion lesions, root caries, and other conditions by eliminating the need for mechanical retention by way of a cavity preparation. Buonocore (1955) introduced a method for increasing the bond strength of composite resins by acid etching of the enamel. However, the willful etching of dentin has not been an accepted technique in the United States because of the different structure of dentin as well as the potential harm to pulpal tissues that may result, according to Buonocore (1975), Brännström and Nordenvall (1977), and Stanley, Going, and Chauncey (1975).

The clinical success of adhesively bonding restorative materials to dentin has been reported with the glass-ionomer cements by Mount (1981), and with an NPG-GMA resin by Flynn

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(1979). These tooth-colored restorative materials have been shown to be effective in the treatment of class 3 and class 5 restorations. The bond strengths of glass-ionomer cements to dentin have been found by Hotz and others (1977) and Coury and others (1982) to surpass the cohesive strength of the material itself. However, certain disadvantages have been noted concerning the clinical use of this type of cement. Esthetics is somewhat compromised by a lack of translucency, and the current materials have low tensile and shear strengths as reported by Powis and others (1982) and Maldonado, Swartz, and Phillips (1978). Also, a second appointment has been required for final finishing, according to McLean and Wilson (1977), as the setting reaction is prolonged and the material has insufficient resistance to either hydration and/or dehydration. With the composite resins, however, the esthetics is improved and the setting reaction is relatively rapid.

In 1981, a glass-ionomer restorative material, Ketac-Fil, was introduced and reported by ESPE (Fasbrik Pharmazeutischer, Oberbay, W Germany) to have a more rapid setting reaction than previous formulations.

The manufacturer suggested that the material could be finished to its final form 15 minutes after placement. The purpose of this investigation was to evaluate the clinical performance of three materials used for restoring dental cervical abrasion/erosion lesions over a three-year period and to examine the influence of immediate finishing (15 minutes) versus delayed finishing (at least 24 hours) of the glass-ionomer cement. The following six properties were evaluated: (1) retention, (2) anatomical form, (3) staining, (4) marginal discoloration, (5) marginal adaptation, and (6) surface roughness.

METHODS AND MATERIALS

Thirty adult patients, each with at least four cervical erosion/abrasion lesions, participated in the study. The three restorative materials used were: (1) Ketac-Fil (ESPE), a precapsulated Type II glass-ionomer material; (2) Chelon (ESPE), a powder/liquid Type II glass ionomer from the same manufacturer; and (3) Cervident (S S White Dental Products, King of Prussia, PA 19406). The placement of all restorative materials was accomplished under a rubber dam. The

selection of the material for the various lesions was by computer randomization. The treatment of each tooth was completed before the placement of the next restoration was started. When necessary, only topical anesthesia was used for retainer clamp placement for the comfort of the patients. There was no removal of tooth structure for retention points with any of the materials.

The lesions were scrubbed lightly with a fine pumice and water slurry using a rubber cup. The pumice was thoroughly washed off with a water rinse and the teeth were dried. All lesions restored with glass-ionomer cement were further cleaned for 15 seconds with 25% polyacrylic acid on a cotton pellet. After rinsing, a cervical matrix form (Premier Dental Products, Morristown, PA 19401) was glued onto the end of an amalgam condenser which had been smoothed at one end. The matrix was adapted to the margins of the lesion with a wax spatula. An index mark was placed on the tooth and matrix for rapid and accurate future replacement of the matrix. Mixing and placement of the cements were done according to manufacturers' instructions. The Ketac-Fil capsules were activated and placed in a Vari-Mix II triturator (Kerr Mfg, Romulus, MI 48174) at H-1 setting for 10 seconds. The H-1 setting was precalibrated to triturate at 4000 cycles per minute. After mixing, the material was quickly placed into the lesion and covered by the contoured matrix. The Chelon was mixed by hand to the same consistency as the Ketac-Fil, placed into the lesion, and the matrix placed. After three minutes, the condenser was twisted from the matrix and the restoration allowed to set for an additional 12 minutes. The initial finishing, after 15 minutes, was accomplished using a Bard Parker blade handle with a #12 scalpel to remove gross flash.

Since ESPE recommends early finishing, the Chelon restoration and one of the Ketac-Fil restorations were final-finished 15 minutes after placement, using Sof-Lex disks (3M Dental Products, St Paul, MN 15544) in a slow-speed handpiece with water. The final finishing of the other Ketac-Fil restoration was delayed for at least 24 hours, as is specified by other glass ionomer manufacturers, and was accomplished under a rubber dam where access to the margin was difficult to obtain. All glass-ionomer restorations were varnished before the patient was dismissed. The enamel surrounding the lesions restored with Cervident was etched with 50%

Table 1. Criteria for Clinical Evaluation

RETENTION

- Alpha - Complete retention
- Bravo - Partial retention
- Charlie - Complete loss

ANATOMICAL FORM

- Alpha - The general contour of the restoration follows the overall contour of the tooth.
- Bravo - The general contour of the restoration does not follow the overall contour of the tooth.

STAINING

- Alpha - No stain on the restoration, or the stain is equal on both the tooth and the restoration.
- Bravo - More stain on the restoration than on the surrounding tooth structure

MARGINAL DISCOLORATION

- Alpha - No discoloration between restoration and tooth
- Bravo - Discoloration on less than half of the circumferential margin
- Charlie - Discoloration on more than half of the circumferential margin

MARGINAL ADAPTION

- Alpha - An explorer does not catch, or exhibits only a one-way catch, when drawn across the restoration-tooth interface.
- Bravo - An explorer exhibits a two-way catch, indicating a crevice, when drawn across the restoration-tooth interface.

SURFACE ROUGHNESS

- Alpha - The body of the restoration does not have any surface defects.
 - Bravo - The body of the restoration has minimal defects.
 - Charlie - The body of the restoration has severe surface defects.
-

phosphoric acid for one minute and rinsed. After the lesion was dried, a coat of the manufacturer's "adhesive promoter" was applied. The powder/liquid was mixed to proper consistency and placed into the lesion. The mixture flowed into the lesion, leaving a smooth feather-edge at all cavosurface margins. After five minutes of polymerization, Sof-Lex disks were used to contour the restoration wherever necessary. All of this work was performed according to the manufacturer's recommendations.

VALUATIONS

Two faculty members of the Department of Operative Dentistry at the Indiana University School of Dentistry experienced in clinical research served as evaluators for this double-blind study. The criteria for each of the six characteristics evaluated are listed in Table 1.

Each evaluator was provided a chairside recorder. The evaluators independently determined each rating. A consensus was required

for any discrepancy between the examiners. Interexaminer agreement is shown in Table 2.

Baseline examinations were made two weeks after placement to avoid any dehydration of the restorations before that time. Only one patient failed to return for the six-month and one-year examinations; however, she was present for the two- and three-year examinations.

RESULTS

Retention

Clinical results in Figure 1 show that the restoration of the glass-ionomer materials was significantly better than the composite resin. After three years, 87% of the Ketac-Fil finished at 15 minutes, 90% of the Chelon, 90% of the Ketac-Fil finished at 24 hours, and 47% of the Cervident restorations were completely retained. This characteristic is of principal importance as complete loss of the restoration obviously makes it impossible to measure any other parameter (Table 3).

Anatomical form

The percentage of Alpha rating at examination after three years of Ketac-Fil finished at 15 minutes was 96%; Chelon, 89%, Ketac-Fil finished at 24 hours, 100%, and Cervident, 93% (Fig 2).

Staining

At the three-year examination, all four types of restorations had 100% Alpha ratings for this characteristic (Fig 3).

Table 2. Interexaminer Correlation

Examination	Interexaminer Correlation %
Baseline	76
Six months	78
One year	82
Two years	89
Three years	85

Marginal discoloration

The percentage of Alpha ratings reported at the three-year point for Ketac-Fil finished at 15 minutes was 74%; for Chelon, 79%; Ketac-Fil finished at 24 hours, 79%; and Cervident, 87% (Fig 4).

Marginal adaptation

The percentage of Alpha ratings reported at the three-year point for Ketac-Fil finished at 15 minutes was 85%; Chelon, 71%; Ketac-Fil finished at 24 hours, 86%; and Cervident, 80% (Fig 5).

Surface roughness

The entire surface of each restoration was initially smooth; however, after contouring to the final finishing stage, some surface roughness (minor pitting) was noted in many of the restorations. At the end of three years, Alpha ratings were Ketac-Fil (15 min), 44%; Chelon, 43%; Ketac-Fil (24 hours), 41%; and Cervident, 67%.

Table 3. Percentage of Restorations Retained for Evaluation at Various Examinations

	Sample Size Patients	Restorations Evaluated			
		Ketac-Fil (15 min)	Chelon	Ketac-Fil (24 hours)	Cervident
		% n	% n	% n	% n
Baseline	30	100 (30)	100 (30)	100 (30)	97 (29)
Six months	29	100 (29)	97 (28)	100 (29)	76 (22)
One year	29	100 (29)	97 (28)	100 (29)	69 (20)
Two years	30	90 (27)	93 (28)	97 (29)	50 (15)
Three years	30	90 (27)	93 (28)	97 (29)	50 (15)

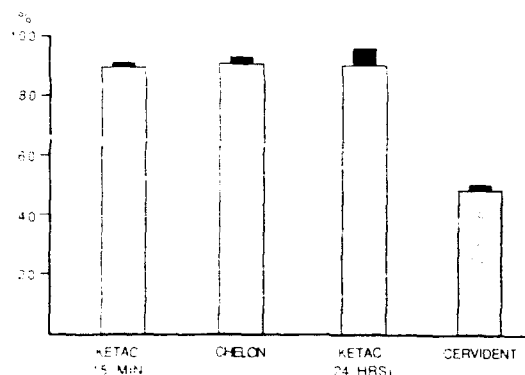


FIG 1. Alpha rating (shaded bars) and Bravo rating (solid bars) for retention at three years

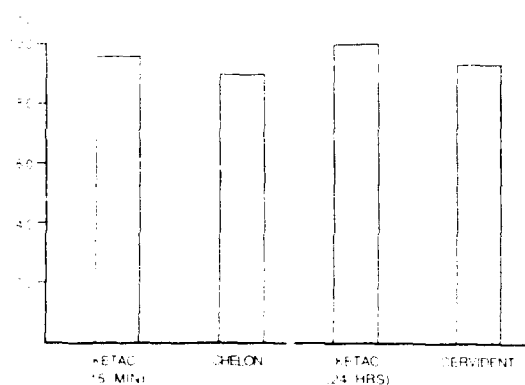


FIG 2. Alpha rating for anatomical form at three years

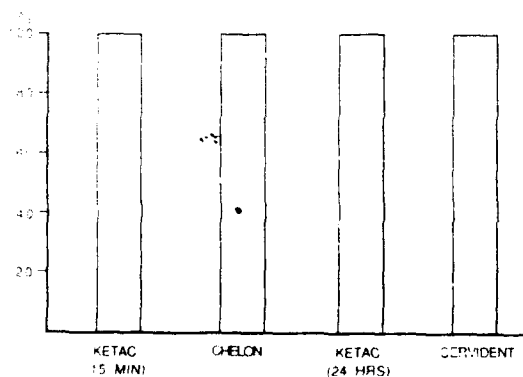


FIG 3. Alpha rating for staining at three years

Only Chelon had 3% Charlie ratings for surface roughness (Fig 6).

DISCUSSION

Retention is an essential property for any restoration. Mount (1981) reported placing over 2100 glass-ionomer restorations in vivo over a six-year period. Over 1283 restorations were rechecked with a 93% retention rate. His observations are similar to the three-year data collected from this study. Flynn (1979) reported 77% and Jendresen (1978) 62% retention of Cervident three years after placement. Reisick, Sellers, and Shutte (1978) reported 73% retention after one year, and Harris, Phillips, and

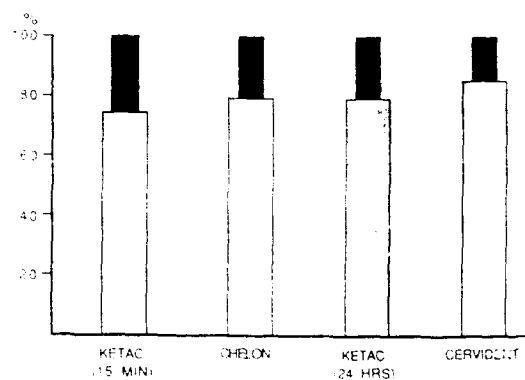


FIG 4. Alpha rating (hollow bars) and Bravo rating (solid bars) for marginal discoloration at three years

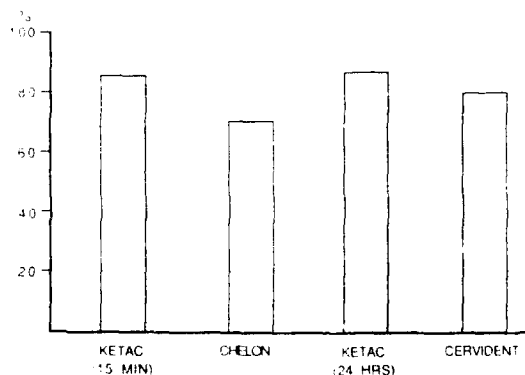


FIG 5. Alpha rating for marginal adaptation at three years

Swartz (1974) noted 50% retention after six months with Cervident. In this study only 50% of the Cervident restorations were present at three years. The retention of Cervident in relation to the glass-ionomer restorations is statistically different at the 0.05 level of confidence at the end of three years, using the Multigroup Generalized Wilcoxon Test.

Early final finishing of Ketac-Fil does not appear to negatively affect any of the six parameters evaluated. The evaluations of anatomic form, staining, and marginal adaptation of the glass ionomer and the composite resin restorative material reported in this study compare favorably with a study by Timmons, Laswell, and Robinson (1983) of eight composite resins.

Krauser (1986) reviewed hypersensitive teeth and suggested that glass-ionomer cement ap-

weeks, sensitivity to cold returned to two of the nine patients.

Table 4. *Dentinal Hypersensitivity after Treatment in 30 Patients with Moderate to Severe Erosion/Abrasion*

Reported by Patient	Immediately		Two-Weeks	
	n	%	n	%
Not present before/not present after	18	60	20	67
Present before/not present after	9	30	7	23
Not present before/present after	3	10	1	3
Present before/present after	0	—	2	7

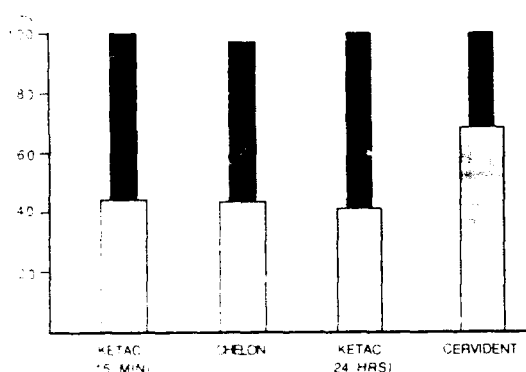


FIG 6. Alpha rating (shaded bars) and Bravo rating (solid bars) for surface roughness at three years

pears promising as a restorative material in terms of decreasing sensitivity. Shortly after placement of the glass-ionomer restorative materials, a questionnaire was completed by the 30 patients involved in this study. All patients had moderate to severe abrasion/erosion lesions. All of the patients who experienced sensitivity before the procedure were free of hypersensitivity immediately following the placement of the restorations (Table 4). Although three patients developed sensitivity, it was gone within one week for two of the three patients, suggesting that the sensitivity was probably due to irritation from the isolation and finishing of the restoration and not from the material itself. Within two

CONCLUSIONS

The three-year data indicate that glass-ionomer cement restorations are outstanding in their retentive property. The established chemical adhesion of this system has again been substantiated *in vivo*. Based upon the results of this study, the glass-ionomer cements used here offer an improved alternative to the composite resin used when no tooth preparation is desirable. The final finishing of Ketac-Fil can be accomplished 15 minutes after placement without negative sequelae.

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